(68p) and the patient (80p). The two home tests were of comparable cost to the NHS (49p for blood spots, 45p for strips). Costs of materials for all three methods were similar (20p). Blood spots cost the patient 19p in postage, but strips brought to the clinic did not cost the patient anything.

Comment

The results show a strong preference for home testing, although most patients had no experience of finger pricking. Many patients found the visit to the laboratory after fasting inconvenient. Patients produced significantly better blood spots than reagent strips, probably because it requires more practice to produce satisfactory strips.

We conclude that patients find producing blood spots on filter paper or reagent strips at home and sending them by post before clinical review to be

an attractive method of measuring fasting glucose concentration and cheaper than attending a laboratory.

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- 1 Gabbay KH, Hasty K, Breslow JL, Ellison RC, Bunn HF, Gallop PM. Glycosylated haemoglobins and long-term blood glucose control in diabetes mellitus. *J Clin Endocrinol Metab* 1977;44:859-64.
- 2 Muir A, Howe-Davies SA, Turner RC. General practice care of non-insulin-dependent diabetes with fasting blood glucose measurements. *Am J Med* 1982;73:637-40.
- 3 Wakelin K, Goldie DJ, Hartog M, Robinson AP. Measurement of capillary blood glucose in filter-paper spots: an aid to the assessment of diabetic control. *Br Med J* 1978;iii:468-9.
- 4 Paisey R, Bradshaw P, Hartog M, West P. Home monitoring of blood glucose using filter paper strips. *Br Med J* 1979;iii:1509.
- 5 Gamlen TR, James HC, Batstone GF. The determination of blood spot glucose concentration using a rapid kinetic assay. *Scand J Clin Lab Invest* 1982;42: 643-5.

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Waldenström's macroglobulinaemia: three cases in shoe repairers

Lorna M Williamson, Michael Greaves, Jonathan R Waters, C C Harling

Department of Haematology, Royal Hallamshire Hospital, Sheffield S10 2JF
Lorna M Williamson, MD, senior registrar
Michael Greaves, FRCP, senior lecturer and consultant

Department of Occupational Health, Northern General Hospital, Sheffield S5 7AU
Jonathan R Worters, MRCP, locum senior registrar
C C Harling, MFOM, consultant

Correspondence to: Dr L M Williamson, Regional Transfusion and Immunohaematology Centre, Cambridge CB2 2PT.

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Waldenström's macroglobulinaemia is an uncommon, low grade lymphoproliferative malignancy of the elderly characterised by infiltration of the bone marrow by plasmacytoid lymphocytes and high serum concentrations of IgM paraprotein, causing hyperviscosity. Its cause is unknown, and no risk factors for its development have been described. We were surprised to find that, of six patients with Waldenström's macroglobulinaemia, three had worked for long periods as shoe repairers.

Case histories

The three patients were men aged 64, 57, and 83 respectively at presentation. All fulfilled the diagnostic criteria for Waldenström's macroglobulinaemia—that is, they had extensive infiltration of the bone marrow and a high plasma monoclonal IgM κ concentration (table). All three developed mucosal bleeding, and in cases 1 and 2 the abnormalities of coagulation were consistent with those in von Willebrand's disease, which is a rare complication of paraproteinaemia. Coagulation returned to normal after treatment with cyclophosphamide.

All three patients had worked for more than 40 years in family shoe repairing businesses and had been exposed to leather, rubber adhesives, dyes, and paints. None of them had taken any specific protective precautions, though modern finishing machines contain extractor fans, and they had not monitored dust and solvent levels. Furthermore, two of them had lived

above their shops, and one stated that when the fumes in the shop became excessive the door leading to the living quarters was opened to clear the air.

Comment

Our patients were exposed to leather and rubber dust when cutting and buffing soles and heels, which were previously made from natural rubber and are now made from synthetic, vulcanised styrene-butadiene rubber. Before the second world war the adhesive used in shoe repairing was natural rubber solution, consisting of natural rubber dissolved in petroleum naphthas such as benzene, alkylbenzenes, and paraffins. Cellulose cement softened with amyl acetate was also used. Synthetic rubber cements consisting of polychloroprene (Neoprene) or polyurethane dissolved in organic solvents have been used since the 1950s. Shoe dyes were often alcohol based—for example, nigrosine black.

In 1985 Waldenström's macroglobulinaemia was mentioned in 117 death certificates in England and Wales (population 49.9 million),¹ giving a potential death rate of 1/430 000 a year. In the year 1984-5 the Leukaemia Research Fund's centre for clinical epidemiology registered 98 new cases (59 men and 39 women) from a population base of 20 million, giving an incidence of about 1/200 000 a year (R A Cartwright, personal communication). The 10% sample of the 1981 census recorded 530 shoe repairers in Great Britain (Office of Population Censuses and Surveys, unpublished data), of whom 106 were in the 55-64 age group. Thus the number of elderly and retired shoe repairers in the catchment population of 300 000 from which our three patients came would be unlikely to be more than 20. Thus the observed incidence of Waldenström's macroglobulinaemia among shoe repairers in the Sheffield area is many times greater than expected.

Because the calculated death rate from Waldenström's macroglobulinaemia is of the same order of

Details of three shoe repairers with Waldenström's macroglobulinaemia

Case No	Serum IgM (g/l)*	Kaolin cephalin clotting time (seconds)		Factor VIII (coagulant activity) (IU/l)†	Factor VIII (ristocetin cofactor) (IU/l)†	Factor VIII (von Willebrand factor) (IU/l)†
		In patient	Control value			
1	54	56	41	350	400	180
2	55	55	39	370	160	190
3	54	41	39	NA	NA	NA

*Normal range=0.5-2.0 g/l.

†Normal range for all three VIII components=500-1500 IU/l.

NA=Not available.

magnitude as the incidence estimated from the Leukaemia Research Fund the condition is unlikely to be appreciably more common than our figures suggest. Statistical analysis is inappropriate for the small number of cases reported here, but, unless the calculation of the population of elderly shoe repairers at risk in our area is a large underestimate, our findings suggest an association between the occupation and the disease. Several other malignant conditions also seem to be more common in workers manufacturing shoes and other leather goods, including cancers of the nose and paranasal sinuses,² bladder,³ and rectum.⁴ An increase in perinatal loss has also been reported in women in the leather industry, for which solvents and glues have been implicated.⁵ Careful assessment of the patient's occupation in new cases of Waldenström's macroglobulinaemia coupled with case-control studies and surveys of the incidence of paraproteinaemias in leather

workers are needed to ascertain the importance of our findings.

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- 1 Office of Population Censuses and Surveys. *Mortality statistics: cause*. London: HMSO, 1985. (Series DH2 No 12.)
- 2 Acheson ED, Cowdell RH, Rang EH. Nasal cancer in England and Wales: an occupational survey. *Br J Ind Med* 1981;38:218-24.
- 3 Cole P, Hoover R, Friedell GH. Occupation and cancer of the lower urinary tract. *Cancer* 1972;29:1250-60.
- 4 Pippard EC, Acheson ED. The mortality of boot and shoe makers, with special reference to cancer. *Scand J Work Environ Health* 1985;11:249-55.
- 5 Clarke M, Mason ES. Shoe manufacture and possible hazards to reproduction. *Br Med J* 1988;296:466.

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Iron deficiency in adolescents

Paul L Armstrong

General Practice Training Unit, General Hospital, Sligo, Republic of Ireland
Paul L Armstrong, DRCOG, general practice trainee

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There has recently been considerable speculation about iron deficiency in young people, and the need for community based surveys to assess the size of the problem has been emphasised.¹ As little is known about iron deficiency in adolescents in the British Isles this study aimed to assess its prevalence.

Subjects, methods, and results

The subjects were students from the five second level schools in Sligo, north west Ireland (population 20 000; located at sea level). Of 439 students in the fourth year, 234 agreed to take part in the study; both the students and their parents gave written consent. The students who took part and those who did not were similar in age and sex. One hundred and forty eight subjects who took part were female and 86 male. They ranged in age from 14.5 to 18.4 years (mean 15.9). A full blood count was carried out for each of the students and blood samples analysed with a Coulter counter (S8 80). Serum ferritin concentration, which is an accurate estimate of iron stores,² was assayed with a Becton Dickinson radioimmunoassay kit (I-125).

The mean haemoglobin concentration was 137 g/l overall. In the young men the mean was 143 (range 103-166) g/l, and in the young women the mean was 133 (range 102-154) g/l. Eleven (13%) of the young men had haemoglobin concentrations <130 g/l, and 11 (7%) of the young women had haemoglobin values <120 g/l. The mean ferritin concentration was 16.0 µg/l overall, being 17.3 µg/l in the young men (range 2.1-87.3) and 15.3 µg/l in the young women (range 2.1-122.4). Ferritin concentrations were <10 µg/l in 40% of the subjects (30 young men and 64 young women) and 10-20 µg/l in 35% (30 young men and 51 young women). The mean haemoglobin concentration in the group with a ferritin concentration <10 µg/l was 133 g/l and that in the group with a ferritin concentration ≥10 µg/l was 139 g/l ($p < 0.001$).

Comment

Iron depletion is said to correspond with serum ferritin concentrations <10 µg/l.³ On this basis 40% of the adolescents in this study were iron depleted, which is an unexpectedly high proportion. As there are no other reports of the iron state of adolescents in the British Isles, however, these results may represent normal values for adolescents. Results were obtained for a fairly high number of students (53% of the sample population) considering their age and that blood sampling was necessary.

In clinical practice the haemoglobin concentration (along with red cell variables) is usually used in diagnosing iron deficiency; at the recommended cut off points of 130 g/l for young men and 120 g/l for young women⁴ the numbers of adolescents diagnosed as anaemic were higher than expected. Again, no comparable data are available and these cut off points for diagnosing anaemia in this group are arbitrary. The haemoglobin concentrations of the students with low ferritin concentrations indicate the low sensitivity when haemoglobin concentration is used as the criterion for iron depletion.

Iron deficiency is said to be the most prevalent nutritional disorder in the world today,⁵ yet no studies have defined either the normal values or the extent of the problem in adolescents in the British Isles. This study indicates that iron state in this age group warrants further evaluation and research.

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- 1 Addy DP. Happiness is: iron. *Br Med J* 1986;292:969-70.
- 2 Jacobs A, Worwood M. Ferritin in serum. Clinical and biochemical implications. *N Engl J Med* 1975;292:951-6.
- 3 Jacobs A, Miller F, Worwood M, et al. Ferritin in the serum of normal subjects and patients with iron deficiency and iron overload. *Br Med J* 1972;iv:206-8.
- 4 Dallman PR, Siimes MA. Percentile curves for hemoglobin and red cell volume in infancy and childhood. *J Pediatr* 1979;94:26-31.
- 5 Stoskman JA. Iron deficiency anaemia: have we come far enough? *JAMA* 1987;258:1645-7.

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